Planning Period 2020 – 2040

Wastewater Facilities Plan

GRW Project No. 4858

City of Brandenburg, KY

December 2020

CITY OF BRANDENBURG

engineering | architecture | geospatial

GRW | 9710 Bunsen Parkway | Louisville, KY 40299 | 502.489.8484

Wastewater Facilities Plan
City of Brandenburg, Kentucky
Planning Period 2020 - 2040

Mayor

The Honorable Ronnie Joyner

Public Works Director

T.J. Hughes

City Council Members

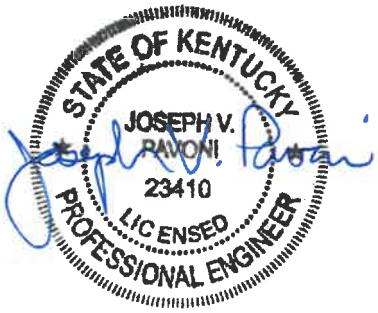
Bruce Fackler

Bryan Claycomb

Maggie Love

Bradley Johnston

Bill Basham



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Wastewater Facilities Plan
City of Brandenburg, Kentucky
Planning Period 2020 – 2040

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Chapter 1
Executive Summary

A. ***Purpose***

The City of Brandenburg, in cooperation with the Kentucky Division of Water (KDOW), determined that their 1990 Wastewater Facilities Plan needed to be updated. Brandenburg's Wastewater Treatment Plant (WWTP) had numerous KPDES permit violations between May 2011 and December 2015, which resulted in the City entering into an Agreed Order on June 14, 2016 with the Kentucky Energy and Environment Cabinet Division of Enforcement. One of the Agreed Order requirements was for the City to complete a Corrective Action Plan (CAP) to bring the WWTP back into compliance. The CAP recommended that the City update their Wastewater Facilities Plan. GRW Engineers, Inc. was selected and contracted by Brandenburg to update that Facilities Plan. An updated facilities plan was completed and approved in 2017.

Since the completion of the 2017 Facility Plan, the City of Brandenburg and Meade County have attracted a Nucor Corporation steel production facility. The impact of the Nucor facility includes revised population and flow projections, as well as changes to the anticipated land uses over the new 2020 – 2040 planning period.

B. ***Background***

The existing Brandenburg WWTP in Brandenburg, Kentucky is located on Buttermilk Falls Road east of downtown Brandenburg. The plant discharges near National Hydrography Dataset (NHD) mile point 643.3 of the Ohio River, segment 08217. It currently has a design treatment capacity of 0.312 million gallons per day (MGD) with a peak hydraulic capacity of 0.932 MGD. The plant was constructed in 1993 to replace the original WWTP built in 1963.

The Brandenburg wastewater collection system is considered "separate" as opposed to "combined", which means that there are separate pipes dedicated to transporting storm and sanitary flows. The collection system was originally constructed in the early 1960's and encompassed downtown Brandenburg, as well as areas south of downtown. Since that time, the sewer system has expanded to accommodate the City's population growth. Due to Brandenburg's topography, the system is primarily gravity flow, but requires numerous lift stations with short force mains.

C. ***Planning Period***

In accordance with the provisions of Section 401 KAR 5:006, the Planning Period for the Brandenburg Facilities Plan Update will be over a 20-year period, and will include the period of time from 2020 to 2040.

D. ***Planning Area***

The existing Brandenburg Planning Area was delineated and approved in the 2017 Wastewater Facilities Plan and included the area within the city limits. The planning area boundary has been further evaluated from the 2017 plan for the purposes of this study. The rationale behind evaluating the boundary was based on the city limits potential growth, as well as to reflect the geographic areas in which it is feasible for the City of Brandenburg to provide wastewater service over the next 20 years. At the time of this document's submittal to KDOW, the formally approved planning area boundary is the one contained in the 2017 Facilities Plan. No changes are anticipated in the geographic size of the 2020 Planning Area. However, the installation of a Nucor Corporation steel processing facility in the far eastern portion of the 11-20 year expansion area will change some land use characteristics, population projections, flow projections, and recommended improvements which have been used for the purposes of this update.

Exhibit 1-1 shows Brandenburg's 2020 Planning Area Boundary, as well as the 0-2 year, 3-10 year and 11-20 year expansion areas.

E. Planning Methodology

This study will develop a plan for the most environmentally sound, cost-effective and implementable wastewater collection and treatment system improvements. It will investigate the effectiveness of the existing treatment plant, the proposed treatment plant alternatives, as well as the ability of the collection system to meet all applicable Federal, State and local requirements. Specifically, this planning document shall objectively evaluate the combined effect of a two component analysis: 1) Cost Effective Analysis and 2) Non-monetary Effectiveness Analysis.

Each alternative under consideration was evaluated using a systematic approach to obtain a ranking for each of the two analysis components.

The systematic approach for evaluating alternatives within the framework of each component consisted of:

1. Cost Effective Analysis

The Cost Effective Analysis involved comparing the cost associated with each alternative based on the present-worth cost analysis method.

2. Non-monetary Effectiveness Analysis

The Non-monetary Effectiveness Analysis includes both the Environmental Impact Analysis and the Implementation Analysis.

F. Population Projections

The most recent census data, as well as population projections for Brandenburg and Meade County, are as follows:

Table 1-1
Brandenburg and Meade County
Population Projections

Year	Meade County	Brandenburg
2020	29,957	2,880
2025	27,387	2,657
2030	26,632	2,584
2035	25,127	2,497
2040	24,675	2,395

The justification for the Table 1-1 figures can be found in Chapter 3. It includes an anticipated increase in population based on approximately one half of the 450 person Nucor Corp workforce being locally sourced and one half relocating to the Meade County-Brandenburg area. Additionally, the projection includes population associated with business and industry ancillary to the Nucor Corp facility. The updated Brandenburg population projections were used in conjunction with proposed land use for preparing wastewater flow and pollutant load projections.

G. Wastewater Flow Projections

Wastewater flow projections for the Brandenburg Planning Area for the year 2040 (end of 20 year planning period) are as follows:

Table 1-2
Planning Area Wastewater Flow Projections
Year 2040

Service Area	Average Flow (MGD)	Peak Flow (MGD)
Existing Service Area	.190	.570
Expansion Area No. 1	-	-
Expansion Area No. 2	.157	.471
Expansion Area No. 3	.149	.447
Total	.496	1.488

The projected 2040 flows are approximately 0.500 MGD average daily flow and 1.500 MGD peak hydraulic flow. The justification for the Table 1-2 figures can be found in Chapter 4.

H. Existing and Proposed Treatment Plant Capacity

The following table summarizes the current and proposed (2040) Brandenburg WWTP capacity:

Table 1-3
Current and Proposed
Brandenburg WWTP Capacity

Influent Parameter	Current Design Capacity	Proposed Design Capacity
Avg Daily Flow (MGD)	0.312	.500
Peak Hourly Flow (MGD)	0.932	1.5
BOD_5 (lbs/day)	870	1,685
BOD_5 (mg/l)	334	404
TSS (lbs/day)	840	1,280
TSS (mg/l)	323	384
Ammonia-Nitrogen (mg/l)	27	37
Phosphorus (mg/l)	-	-
Total Nitrogen (mg/l)	-	-

The justification for these figures can be found in Chapter 4. The proposed design capacity and all upgrades will be implemented in an effort improve the treatment process and meet the KPDES permit limits.

I. Existing Effluent Limits

The existing KPDES permit effluent limits are presented in Appendix C. A summary of the existing KPDES permit effluent limits are presented in Table 1-4.

Table 1-4
Existing Monthly Average
KPDES Permit Limits

Effluent Parameter	Value
BOD_5	30 mg/l
TSS	30 mg/l
Ammonia-Nitrogen	20 mg/l
Total Phosphorus	Monitor
Dissolved Oxygen (min.)	2 mg/l
Total Residual Chlorine	N/A (see Note below) .011 (if used)
Total Nitrogen	Monitor
pH (min./max.)	6.0/9.0 SU
E. Coli	130 #/100ml

NOTE: In May 2017, Brandenburg WWTP replaced the existing chlorination and de-chlorination disinfection system with a Peracetic Acid (PAA) disinfection system. The permit modification became effective December 1, 2019. The permit expiration date of January 31, 2021 did not change. The modified permit is presented in Appendix C.

J. Treatment Plant Alternatives

Various treatment plant alternatives were evaluated for the WWTP with the objective of eliminating KDPES permit violations and providing sufficient treatment capacity for current and future flows and waste loads. The following treatment alternatives were evaluated:

Table 1-5
Treatment Alternatives

Alternative 1	Oxidation Ditch and Secondary Clarification
Alternative 2	Lagoon and Polishing Reactor
Alternative 3	Alternate Option by Different Design Build Team

As indicated, Brandenburg modified the disinfection system in October 2019. Therefore, there was no need to further evaluate disinfection options. PAA will be the disinfection system used with the selected treatment alternative.

A discussion and analysis of each of the treatment alternatives can be found in Chapter 6.

K. Present Worth Analysis

The present worth analysis values for each of the treatment alternatives are summarized in Table 1-6.

Table 1-6
Present Worth Values for Treatment Alternatives

Alternative 1 – Oxidation Ditch and Secondary Clarification	$15,591,000
Alternative 2 –Lagoon and Polishing Reactor	$11,001,000
Alternative 3 – Alternate Option by Different Design Build Team	N/A

A Present Worth value for Alternatives 3 was not available. The Present Worth for the Oxidation Ditch exceeds the Lagoon option, however the Oxidation Ditch was the preferred option as it provides operational flexibility and expansion advantages that outweigh the cost differential. A more detailed summary of the present worth analysis is provided in Exhibit 1-2. A discussion of the present worth analysis for the treatment alternatives can be found in Chapter 6

L. Non-monetary Effectiveness Analysis

The Non-monetary Effectiveness Unit (NEU) analysis of each treatment alternative is summarized in Table 1-7 (the alternative with the lowest NEU score is the preferred alternative from a Non-monetary Effectiveness perspective).

Table 1-7
Non-monetary Effectiveness Unit (NEU) Ratings

Alternative 1 – Oxidation Ditch and Secondary Clarification	214,457
Alternative 2 – Lagoon and Polishing Reactor	220,904
Alternative 3 - Alternate Option by Different Design Build Team	N/A

A Non-monetary Effectiveness Unit rating was not available for Alternative 3.

Based on Non-monetary Effectiveness analysis the Oxidation Ditch is the preferred treatment alternative due to owner preferences and advantages of the Ditch over the Lagoon. The detailed Non-monetary Effectiveness analysis rating table is presented in Exhibit 1-3 and a further discussion of the Non-monetary Effectiveness analysis is contained in Chapter 6.

M. Collection System Alternatives

The collection system alternatives that were evaluated for the Brandenburg sewer system expansion are identified in Table 1-8.

Table 1-8
Collection System Alternatives

Alternative 1	**Gravity Collection System**
Alternative 2	Vacuum Collection System
Alternative 3	Low Pressure Collection System

The expansion of the existing gravity collection system is the selected alternative. The estimated cost of each of the recommended gravity collection system expansion phases are summarized in Table 1-9.

Table 1-9
Gravity Collection System Expansion Phases Cost Estimate

3-10 Years	$3,273,269
11-20 Years	$4,075,219

The 3-10 and 11-20 year phases are designed to expand the existing collection system. Both phases propose adding neighborhoods currently on Brandenburg's water system to the collection system. The City may or may not choose to serve these potential customers.

Exhibit 1-4 shows the proposed collection system expansion for each phase, and Exhibits 1-5 and 1-6 provides a preliminary total project cost estimate for the recommended 3-10 and 11-20 year phase expansions.

A discussion and analysis of the collection system alternatives and planning phases can be found in Chapter 6.

N. Selected Plan

Treatment Plant: The selected treatment alternative is Alternative 1 – Oxidation Ditch and Secondary Clarification (ODS). The ODS alternative meets all project goals and objectives and attains the best Non-monetary Effectiveness rating. The new plant will expand the current rated 0.312 MGD average daily flow to 0.500 MGD, and expand the 0.932 MGD peak hydraulic flow to 1.5 MGD. Elements of the recommended plant upgrades are described below. The existing facultative lagoons will be abandoned and a closure plan will be completed.
A further discussion of the new plant upgrade is contained in Chapter 7 – Selected Plan.

Liquid Process Stream

The existing pumps in the influent pump station are not capable of pumping the projected peak 1.5 MGD to the new plant site with the largest pump out of service. The plan is to replace the existing pumps with Four (4) new submersible pumps that have a 1.5 MGD capacity with the largest pump out of service. A new platform for the pump station emergency generator and electrical equipment will be located above the 100 Year flood plain elevation. Influent flow measurement will be accomplished with a 10" magnetic flow meter just upstream of the screening channel.

A new screening channel will be constructed and new mechanical screening equipment will be installed. A parallel bypass channel will be equipped with a manual bar screen, allowing for removal of the primary channel from service for maintenance. Each channel will be capable of handling the 1.5 MGD peak hourly flow. An existing WWTP sampler will be repurposed.

A single grit removal system will be constructed consisting of two concrete structures. Grit is collected in a sump and fluidized with plant potable water then pumped to a grit dewatering box in a building adjacent to the system for disposal.

The selected plan includes a two ring, series oriented oxidation ditch. Typical flow patterns introduce screened and degritted influent and Return Activated Sludge (RAS) into the outer ring. Manually actuated valves are included to allow the introduction of influent or RAS to the inner ring as desired to provide operational flexibility. A center "island" with an adjustable fixed weir will house a center drain well with an effluent pipe to the secondary clarifiers. A passive recycle using a diversion gate will divert a small portion of flow from the inner ring back to the outer ring to allow for enhanced nitrogen removal. The ditch can be expanded with a third ring in the future. The third ring can double the plant capacity, as well as allow for biological nutrient removal (BNR) of Phosphorus and Nitrogen if future limits are implemented.

Flow from the oxidation ditch is directed to a secondary clarifier influent splitter box. Flow will enter the bottom of the splitter and overflow a weir wall with two (2) manually actuated weir gates to allow flow balancing between the clarifiers, or remove a clarifier from service for maintenance.

The system includes two (2) center feed, perimeter withdrawal circular clarifiers. The clarifiers will share a common return activated sludge (RAS)/waste activated sludge (WAS)/drain pump station. A solids removal structure shall be integral to the perimeter of each clarifier with the solids removal rate controlled by an individual telescoping valves. The WWTP will retain "Ten States Standards" with one clarifier out of service at ADF conditions and PHF conditions with two clarifiers in service.

Effluent from the clarifiers is combined into a common line as influent to the disinfection contact chamber. The existing Peracetic Acid (PAA) system will be used for disinfection.

The chamber will incorporate a dual-sided maze structure that will allow for the removal of one side of the chamber for maintenance. Each side will have an influent slide gate allowing for half of the structure to be removed from service for cleaning and maintenance. Adjustable weirs at the effluent end of each channel of the contact basin will provide additional capability to adjust contact time. The effluent from the contact chamber will leave through a common well into the Aeration Chamber constructed as part of the disinfection chamber. Aeration will be achieved through the fall over the weir exiting the contact chamber. The aeration chamber will include an underflow baffle between the cells to calm flow prior to a V- notch weir for effluent flow measurement.

An effluent sample well will also be included with the existing sampler being relocated to the discharge sample well. Effluent will gravity flow through a new line and connect to the existing line with a discharge point in the Ohio River.

Solids Process Stream

Solids collected by the secondary clarifiers are removed by a telescoping valve and piped to a RAS/WAS/Drain pump station. The station will contain three (3) identical VFD pumps. Each pump will be capable of supplying 150% of the ADF to the Oxidation Ditch or aerated solids holding tank. An RAS magnetic flow meter in a vault will be installed on a common RAS header. Downstream of the common header and upstream of the RAS magnetic flow meter, a force main for the WAS pumps will "tee" off to feed an aerated sludge holding tank with WAS. This station will also serve as a drainage pump station for the oxidation ditch, clarifiers, disinfection basin and other plant structures.

Scum collected from the clarifiers will discharge to a scum pump station with a chopper pump and discharge through a manually activated valve to a dedicated scum line into the aerated solids holding tank.

The aerated solids holding tank provides temporary storage of wasted solids prior to dewatering operations. The basin will provide 4.1 days of storage based on its working volume and allow for five (5) day per week, eight (8) hour per day dewatering while retaining volume to waste on the additional two days. A telescoping weir for decanting will be provided for return to the oxidation ditch influent, and a gravity drain for solids return to the RAS/WAS/Drain pump station. Two (2) positive displacement blowers will supply a coarse bubble aeration system on the tank floor through a discharge header with valves to isolate individual blowers for maintenance.

Settled solids from the aerated solids holding tank will be pumped to the dewatering unit through a variable frequency driven, progressive cavity feed pump. The pump will supply settled solids through a line with a magnetic flow meter with totalizer capability to the system flocculation system. The control system for the dewatering system will provide start, stop, and speed signals for the feed pump

Dewatering of solids will be accomplished with a rotary press. The press is designed to provide operations the ability to dewater five (5) days per week, eight (8) hours per day. The rotary press is anticipated to produce a 15% - 18% dry solids dewatered cake product for disposal. Filtrate and press wash water will be collected and pumped to the new screening channel. The dewatering system and cake conveyance system modifications will be installed in an existing Control Building which will be modified to house and facilitate removal of a roll-off for dewatered cake.

A new skid mounted factory assembled electrical building will be located near the existing control building, and an emergency generator will be added.

Exhibit 1-7 presents the flow diagram for the selected treatment alternative and Exhibit 1-8 presents the site layout for the selected treatment alternative.

Collection System: The collection system projects identified in the 3-10 and 11-20 year planning phase to expand the existing collection system are in Table 1-10 and 1-11.

Table 1-10 3-10 Year Planning Phase Proposed Collection System Expansion		
Four Oaks Road Neighborhood		
Gravity Sewer	8”	2,440’
Force Main	2”	910’
	4”	1,640’
Duplex Lift Stations	2	
Quail Run and Knollwood Neighborhood		
Gravity Sewer	8”	11,770’
Force Main	4”	2,810’
Duplex Lift Stations	7	

Table 1-11 11-20 Year Planning Phase Proposed Collection System Expansion		
River Edge Road Neighborhood		
Gravity Sewer	8”	5,320’
Windsor Place and Sun Valley Road Neighborhood		
Gravity Sewer	8”	7,820’
Force Main	4”	2,000’
Duplex Lift Stations	1	
Christian Church and Bud Wilson Road Neighborhood		
Gravity Sewer	8”	8,780’
Force Main	2”	1,700’
	4”	4,150’
Duplex Lift Stations	7	

The 3-10 and 11-20 year planning phases will each require numerous duplex lift stations to provide sanitary sewers to each neighborhood. A separate preliminary engineering study would be recommended prior to the design of sanitary sewers to each neighborhood. The preliminary engineering study would investigate the alternative collection systems (i.e. grinders or low pressure force mains) for each neighborhood and recommend the best alternative for providing sanitary sewers to each neighborhood. **The City may or may not choose to serve the potential customers within the 3-10 and 11-20 year phases.**

O. Project Cost Estimate

The total project cost for the recommended plant improvements (Alternative 1 – Oxidation Ditch and Secondary Clarifiers) is estimated at $8,300,600, and the total project cost estimate for the potential collection system expansion in the 3-10 and 11-20 year timeframe are $3,273,269 and $4,075,219, respectively. The total 20 year cost estimate for both the new treatment plant and the collection system expansion is $15,649,088. The City of Brandenburg intends on funding the plant improvements through a Public-Private-Partnership (P3) with the issuance of private bonds.

P. Sewer User Rates

A preliminary sewer use rate analysis has been completed using a total new wastewater treatment plant project cost loan commitment and the anticipated Meade County contribution. No impact fees (i.e. new user tap fees) or recapture agreement fees were considered in the rate analysis. The analysis results are included as Exhibit 9-1.

For funding with a 20 year loan interest rate of 2.65%, sewer use rates are projected to increase across the three user classes established by the City of Brandenburg; Residential, Commercial, and School/Tax Exempt. The following table, Table 1-12, illustrates average rates, by user class at average flows utilizing the rates effective December 1 2020, and average rates in 2040, also by class. The 2040 rates assume a 2.0% annual increase, per ordinance, plus a 1.5% annual increase in expenses and reserves.

Table 1-12 Sewer Use Rates by Class/Year Average Use Rates		
Class	**2020**	**2040**
Residential	$42.05	$62.48
Commercial	$55.17	$81.98
School/Tax Exempt	$105.96	$157.45

It should be noted that these are preliminary rate calculations and a more detailed rate study must be completed in order to verify the actual rate increase required.

The analysis provided here did not factor in other revenue sources such as new user tap fees or recapture agreement fees. In addition, this projected rate increase assumes that the existing finances are neutral and does not include any rate increase which may be necessary to bring current finances to a neutral position.

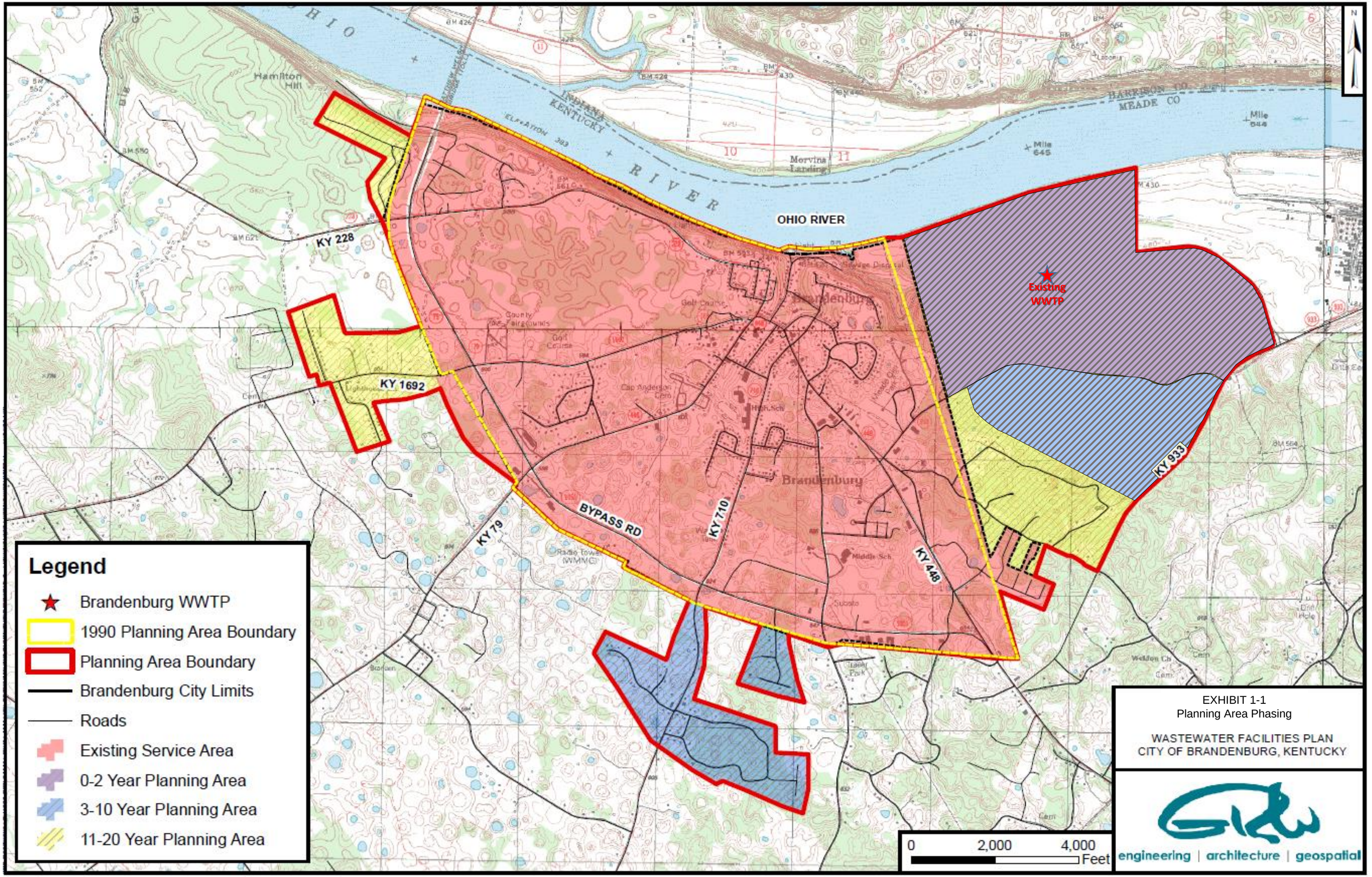

EXHIBIT 1-1
Planning Area Phasing

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

engineering | architecture | geospatial

Exhibit 1-2
Brandenburg Wastewater Treatment Plant
Present Worth Analysis Summary

Biological Treatment Alternatives*

Alternative	Description	Project Cost	Annual O&M	Salvage Value	Total Present Worth
1	Oxidation Ditch/Clarifiers	$8,300,600	$497,763	$497,700	$15,591,000
2	Biological Lagoon	$5,955,600	$337,579	$165,070	$11,001,000
3	Alternate by another design firm	N/A	N/A	N/A	N/A

Both alternatives utilize the Peracetic Acid disinfection operations cost included in the Annual O&M values.

Exhibit 1-3
Brandenburg Wastewater Treatment Plant
Non-monetary Effectiveness Analysis

Parameter	Weight	Alternative 1 Orbal Oxidation Ditch		Alternative 2 Lemna Lagoon		Alternative 3 By Others N/A	
		Rating	Score	Rating	Score	Rating	Score
Environmental Impact	1.00	10	10.00	8	8.00	N/A	N/A
Engineering Evaluation	1.00	8	8.00	4	4.00	N/A	N/A
Implementability	0.90	10	9.00	8	7.20	N/A	N/A
Energy Consumption	0.80	8	6.40	8	6.40	N/A	N/A
Expandability	0.70	9	6.30	1	0.70	N/A	N/A
Chemical Use	0.70	8	5.60	8	5.60	N/A	N/A
Public Support	0.80	8	6.40	4	3.20	N/A	N/A
Institutional & Legal Capability	0.90	10	9.00	10	9.00	N/A	N/A
Regionalization	0.70	10	7.00	1	0.70	N/A	N/A
Land Purchase & Easements	0.50	10	5.00	10	5.00	N/A	N/A
Total Score			**72.70**		**49.80**		**N/A**
Total Present Worth			**$15,591,000**		**$11,001,000**		**N/A**
Non-Monetary Effectiveness Units (NEU)			**214,457**		**220,904**		**N/A**

Note: 1. The **Weight** of each parameter is a measure of the relative concerns of that parameter compared to other parameters, on a scale of 0.0 to 1.0, with the highest weighted parameters being those which are considered the most critical.

2. The **Rating** for each alternative is a measure of the relative implementation concern of that alternative on the parameter compared to other alternatives, on a scale of 0.0 to 10.0, with the highest ratings given to the alternative that best satisfies the parameter.

3. The Non-monetary Effectiveness Unit (NEU) is a measure of the relative implementation concern due to construction and operation of each alternative. The alternative with the **lowest NEU is the most capable of implementation**.

4. Non-monetary Effectiveness Units (NEU) = Total Present Worth/Total Score

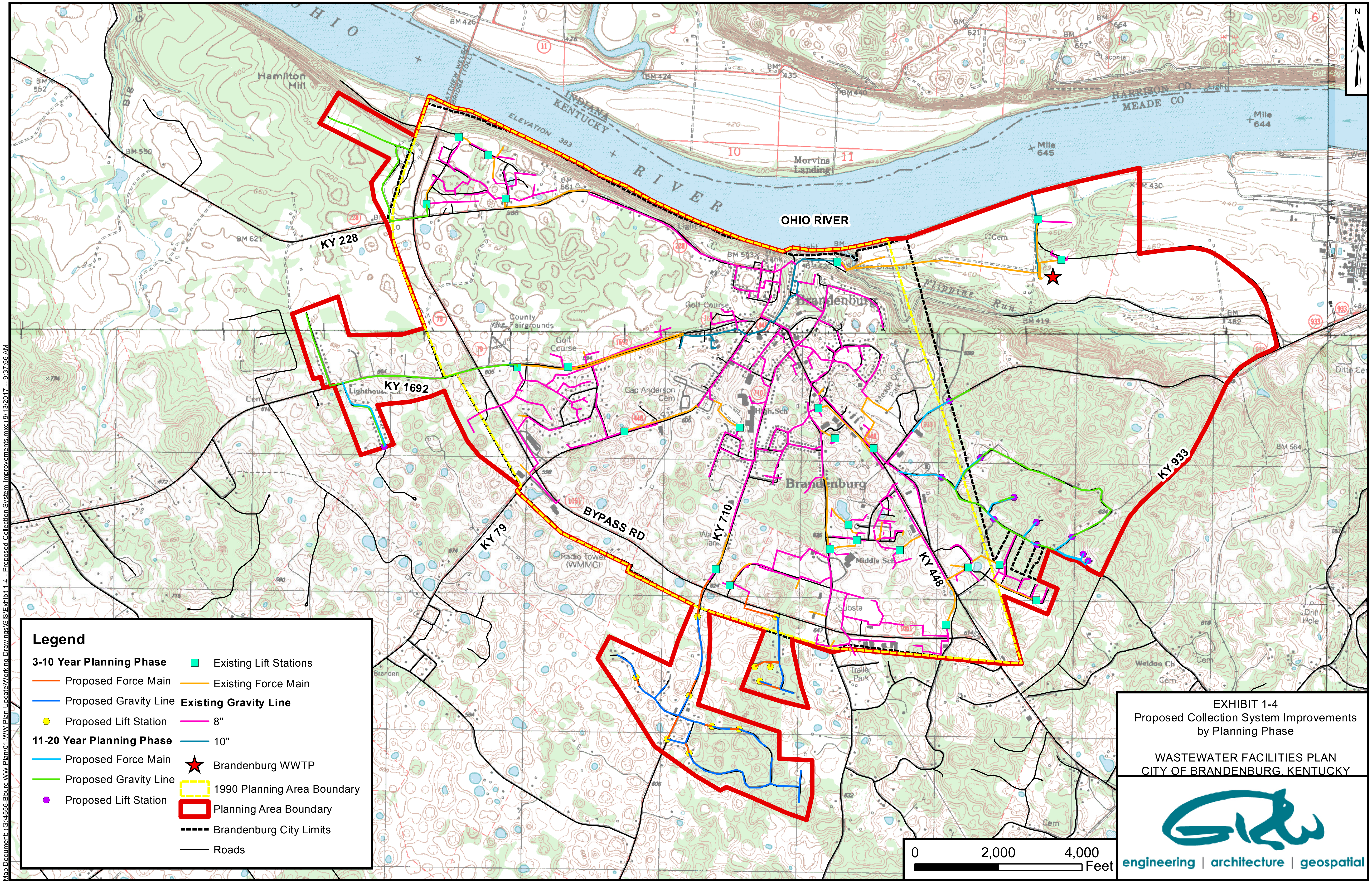
Legend
3-10 Year Planning Phase
Proposed Force Main
Proposed Gravity Line
Proposed Lift Station
11-20 Year Planning Phase
Proposed Force Main
Proposed Gravity Line
Proposed Lift Station
Existing Lift Stations
Existing Force Main
Existing Gravity Line
8"
10"
Brandenburg WWTP
1990 Planning Area Boundary
Planning Area Boundary
Brandenburg City Limits
Roads
EXHIBIT 1-4
Proposed Collection System Improvements
by Planning Phase
WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY
engineering | architecture | geospatial
0
2,000
4,000
Feet
N
OHIO RIVER
KY 228
KY 1692
KY 79
BYPASS RD
KY 710
KY 448
KY 933
Brandenburg
INDIANA
KENTUCKY
HARRISON CO
MEADE CO
Hamilton Hill
Morvins Landing
Mile 645
Mile 644
County Fairgrounds
Golf Course
Cap Anderson Cem
High Sch
Middle Sch
Radio Tower (WMMC)
Trailer Park
Flippins Run
Meade Olin Park
Lighthouse
Substa

Exhibit 1-5
Proposed Wastewater Collection System Improvements
Preliminary Total Project Cost Estimate
3-10 Year Planning Phase

Item	Estimated Cost*
Construction	$2,435,204
Engineering Design	$145,065
Site Surveys	$40,000
Geotechnical Engineering	$60,000
Bidding	$19,000
Construction Administration	$38,000
Resident Inspection	$110,000
Land and Right-of-Way	$20,000
Legal	$10,000
Start Up Services	$30,000
Contingency (15%)	$366,000
Preliminary Total Project Cost Estimate	$3,273,269

* Estimated costs based on 2020 pricing

Exhibit 1-6
Proposed Wastewater Collection System Improvements
Preliminary Total Project Cost Estimate
11-20 Year Planning Phase

Item	Estimated Cost*
Construction	$3,050,563
Engineering Design	$175,656
Site Surveys	$60,000
Geotechnical Engineering	$60,000
Bidding	$23,000
Construction Administration	$46,000
Resident Inspection	$127,000
Land and Right-of-Way	$30,000
Legal	$15,000
Start Up Services	$30,000
Contingency (15%)	$458,000
Preliminary Total Project Cost Estimate	$4,075,219

* Estimated costs based on 2020 pricing

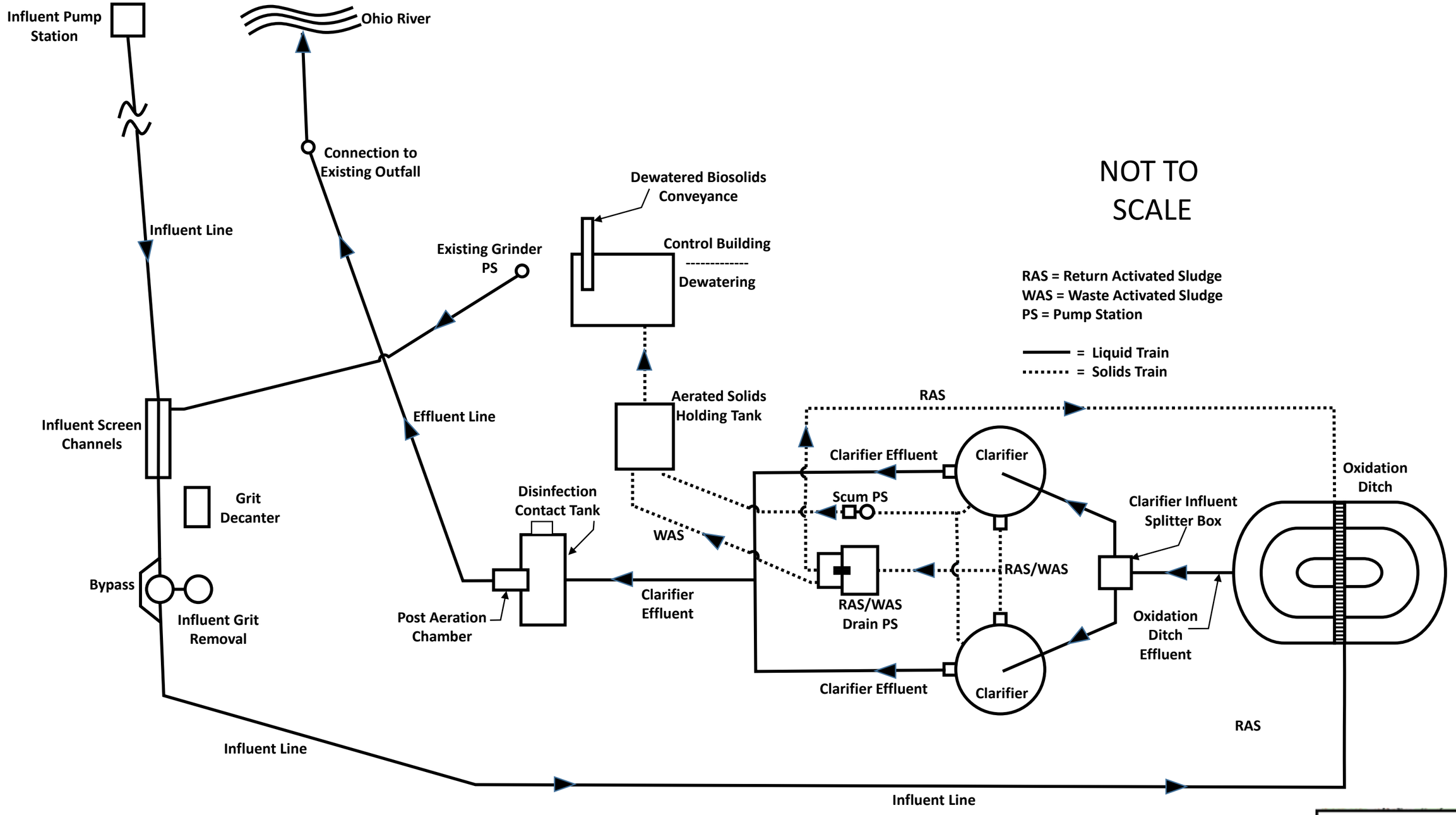

Exhibit 1-7

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

engineering | architecture | geospatial

BUILDING/STRUCTURE NUMBER INDEX

1. INFLUENT SCREENING CHANNEL
2. GRIT REMOVAL (RECOMMENDED, BUT NOT APART OF BASE PROPOSAL)
3. OXIDATION DITCH
4. CLARIFIER SPLITTER BOX
5. CLARIFIER
6. CONTACT BASIN
7. RAS/WAS/DRAINAGE PUMP STATION
8. SCUM PUMP STATION
9. AERATED SLUDGE HOLDING TANK AND PUMPS
10. EX. CONTROL BUILDING (DEWATERING)
11. ELECTRICAL BUILDING
12. GENERATOR
13. EX. GRINDER PUMP STATION

GRW PROJECT NO. 48561

CLIENT PROJECT NO. XXXX

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PROCESS AND PIPING LAYOUT
OXIDATION DITCH OPTION

WASTEWATER TREATMENT PLANT P3
CITY OF BRANDENBURG, KENTUCKY

DESIGNED	JVP
DRAWN	RWG
REVIEWED	JVP
APPROVED	JVP

EXHIBIT 1-8

DATE

SCALE: 1" = 30'

SHEET NO.

OD-1

Chapter 2
Project Background

A. Owner and Purpose

In June of 2016, the City of Brandenburg entered into an Agreed Order (AO Case No. DOW 150453) with the Commonwealth of Kentucky Energy and Environment Cabinet Division of Enforcement. The purpose of the Agreed Order was to resolve compliance issues with the Brandenburg Wastewater Treatment Plant (i.e. KDPES permit effluent limit violations at the outfall of the treatment plant).

One of the requirements of the Agreed Order was for the City submit to Division of Enforcement (DENF) for review and acceptance, a Corrective Action Plan (CAP) to bring the facility into compliance with its KPDES permit. The City of Brandenburg submitted the CAP to DENF on August 15, 2016. The CAP recommended that the City update their Wastewater Facilities Plan (last updated in 1990), and that the WWTP would be upgraded according to the Facilities Plan recommendations. A copy of the CAP, approved on February 1, 2017 via email, can be found in Appendix C.

The City of Brandenburg, in cooperation with the Kentucky Division of Water (KDOW), requested that the Wastewater Facilities Plan be updated at this time. GRW Engineers, Inc. was selected and in, turn completed and delivered a Facility Plan in September 2017.

The purpose of that report was to evaluate the current and future wastewater collection and treatment needs for the Brandenburg Planning Area in accordance with Section 401 of the Kentucky Administrative Regulation (KAR) 5:006. The proposed plan for the wastewater collection and treatment system improvements was, at the time, the most environmentally sound, cost effective, and implementable alternative while also meeting Federal, State, and Local requirements.

Since the completion of the 2017 Facilities Plan, the City of Brandenburg, and Meade County, Kentucky have attracted a major new employer which will locate a steel production facility in the proposed Planning Area encompassed by this 2020 Facility Plan. Nucor Corporation (Nucor) will site a facility immediately to the east of the Brandenburg WWTP in an area identified within the 11-20 year expansion of the Planning area boundary. The Nucor facility will convert acreage to industrial use that was identified in the 2017 Facility Plan as agricultural use. Although Nucor will NOT be sending wastewater flow or loading to the Brandenburg WWTP, their inclusion in the Planning Area coupled with the Nucor acquisition of the existing plant site as a buffer area to their new facility necessitated a reassessment of the treatment alternative selected in the 2017 Plan. The new Brandenburg wastewater treatment plant site is directly south of, and adjacent to the existing plant site.

B. Planning Methodology

This facilities plan will be used as a planning tool for future improvements to the Brandenburg wastewater collection and treatment system. The report will project the changes expected for the 20-year planning period from 2020 to 2040, and investigate the effectiveness of the current collection and treatment system to accommodate that future growth.

This study uses information from discussions and meetings with representatives from: City of Brandenburg staff; Brandenburg City Council; Brandenburg Mayor; and Kentucky Division of Water. The study also uses information from a review of: existing sewer system plans, specifications, and O&M manuals; historical data; the 1990 and 2017 Brandenburg Facilities Plan; Kentucky Geological Survey; and various KDOW documents.

The study will develop a plan for the most environmentally sound, cost-effective, and implementable wastewater collection and treatment system improvements.

This planning document will show the effectiveness of the existing treatment plant, even though a new wastewater treatment plant will be constructed. It will provide treatment data from the 36 month period of July 1, 2017 to June 30, 2020, projected flow over the 20 year planning period and treatment alternatives, and the ability of the collection system to meet applicable Federal, State, and local requirements.

Specifically, this planning document shall objectively evaluate the combined effect of a two-component analysis: 1) cost effectiveness, and 2) non-monetary effectiveness. The non-monetary effectiveness portion will include analyses for the environmental impact and implementability.

Each alternative under consideration was evaluated using a systematic approach to obtain a ranking for each of the two analysis components. The systematic approach for evaluating alternatives within the framework of each component consisted of:

1. Cost Effective Analysis

The Cost Effective Analysis involved comparing the costs associated with each alternative based on the present-worth cost analysis method.

2. Non-Monetary Effective Analysis

The Non-Monetary Effective Analysis included both the environmental impact analysis and the implementation analysis. The environmental impact analysis involved evaluating the system's compatibility with the surrounding environment. Alternative wastewater collection and treatment systems were assessed to determine their environmental impacts and effectiveness. The implementation analysis involved evaluating the practicality of implementing alternatives based on the existing facility, technical issues, and federal, state, and local requirements.

Chapter 6 contains more information regarding the cost effectiveness and non-monetary effectiveness analyses.

C. Compliance Background

1. Agreed Order

As previously mentioned, the City of Brandenburg entered into an Agreed Order with the Commonwealth of Kentucky Energy and Environment Cabinet Division of Enforcement in June 2016 (See Appendix A) due to permit limit violations for BOD_5, TSS, SS% removal, NH_3N, E. Coli. and pH from May 2011 to December 2015. Remedial measures listed in the Agreed Order included: immediate reporting of spills, bypass discharges, upset condition discharges, and releases of substances which would result in the pollution of the waters of the Commonwealth; proper and regular operation and maintenance of the sewage collection system and WWTP; submittal to DENF for review and acceptance, a written CAP to bring the facility into compliance with its KPDES permit; and ceasing of all discharges that degrade the waters of the Commonwealth.

A CAP for the City was prepared and submitted to DENF in August 2016. The CAP recommended updating the City's Wastewater Facilities Plan and upgrading the WWTP according with the Facilities Plan recommendations. A Facilities Plan was completed, delivered, and approved in September 2017. The CAP highlighted work completed at the WWTP between June 2014 and June 2016 in response to the violations. The modifications included: replacement of all 8 aerators, replacement of chlorine and sulfur dioxide pumps, installation of a new clarifier drive and torque control on east clarifier, and various electrical work. The 2017 Facilities Plan also identified upgrades to the existing facility that included dividing the existing lagoon system into an aeration cell and a settling cell, as well as the addition of a polishing reactor to treat high levels of ammonia during the winter months.

D. Planning Period

In accordance with the provisions of Section 401 KAR 5:006, the Planning Period for the Brandenburg Facilities Plan Update will be over a 20-year period, and will include the period of time from 2020 to 2040.

E. Regional Location

The City of Brandenburg is the county seat of Meade County in North Central Kentucky. The county, is located in the Pennyroyal Region of the state, and is bounded on the north by the Ohio River, the south and east by Hardin County, and the west by Breckinridge County.

Meade County has an area of 325 square miles (208,000 acres). The City of Brandenburg is centrally located in the county, and has an incorporated area of approximately 4.24 square miles (2,713 acres).

Brandenburg is geographically located approximately 46 miles southwest of Louisville, Kentucky, approximately 17 miles south of Corydon, Indiana, approximately 26 miles northwest of Radcliff, Kentucky, and approximately 87 miles northeast of Owensboro, Kentucky. Meade County lies in the Ohio River drainage basin.

A map of the region is shown in Exhibit 2-1, a map of Meade County is shown in Exhibit 2-2, and a map of the City of Brandenburg is shown in Exhibit 2-3.

F. Planning Area

The Brandenburg Planning Area was originally delineated in the 1990 Wastewater Facilities Plan (Howard K. Bell). The 1990 Planning Area included the area within the City's 1990 city limits. The Planning Area was modified for the purpose of the 2017 study to reflect wastewater service to geographic areas which were realistically feasible to be served over a 20 year period by the City of Brandenburg. The 2020 study retains the same geographic boundaries, and physical area.

Since the completion of the 2017 plan, however, The City of Brandenburg, and Meade County have completed an agreement with Nucor Corp to site a new steel production facility within the 11-20 year expansion planning area. The conversion of land from agricultural to industrial use, plus the anticipated change in population projections, and associated residential, commercial, and potential light industrial development, will affect the Planning Area make-up.

The 2020 Planning Area has been delineated based on:

- Brandenburg's revised city limits (October 2012),
- Providing service to existing water customers that were outside the 1990 Planning Area,
- Potential industrial and commercial growth coming to the area. The geographic area encompassed in the Planning Area is sufficient in size to permit an unrestricted analysis of alternative waste treatment methods, as well as to clearly identify and evaluate the cumulative environmental impact of the proposed alternatives.
- The submitted and approved 2017 Facilities Plan.

The existing Planning Area was produced for the 2017 Wastewater Facilities Plan and expanded from the 1990 Planning area which encompassed the city limits at that time; approximately 4.13 square miles. Since the 1990 Wastewater Facilities Plan the city limits have expanded slightly to the east to encompass residential growth. See Exhibit 2-4 for the 1990 Planning Area Boundary and land use map.

The boundary of the Planning Area for wastewater service was determined through meetings with the Brandenburg Mayor and City Staff in January of 2017. The 2017 area includes an expansion to the east from the 1990 Planning Area to encompass residential growth. GRW and the City then met with KDOW staff in March of 2017 to review the new planning area boundary which was later approved with the rest of the plan in May 2018. At the time of submission of this 2020 Facilities Plan, no further expansion of the 2017 Planning Areas are anticipated.

The Nucor Corp. land acquisition encompasses areas identified for expansion in the 2017, 0 to 2 Year, and 3 to 11 Year expansion plan. The major difference between 2017 and 2020 being the conversion of land use from agricultural to industrial in the area immediately east and southeast of the existing WWTP.

The Planning Area boundaries consist of roughly: the Ohio River to the north, KY 933 to the east, and KY 1051 to the south and west. The south and west boundary extends past KY 1051 in areas to encompass select neighborhoods currently served by the City's water system. In general, it is within the Ohio River watershed. See Exhibit 2-5 for the Planning Area Boundary and future land use map. See Exhibit 2-6 for Planning Area Phasing. A Larger version of Exhibit 2-6 showing the 2017 planning area can be found in Appendix B.

Through discussions with City Staff and KDOW, it was determined that the City was best suited and most likely to serve the proposed area, and the 2017 Planning Area Boundary was created and adopted. As a result, all population, land use, flow projections, and recommended improvements in this 2020 Facilities Plan are based on the 2017 Planning Area Boundary with modifications due to the inclusion of Nucor and the anticipated effects on population, commercial property, and land use conversion in the 11-20 year planning period. Updated City and County resolutions accepting the Planning Area Boundary can be found in Appendix I.

G. Regionalization

As mentioned previously, Brandenburg is geographically located approximately 26 miles northwest of Radcliff, Kentucky, which has a population of approximately 23,000 people. Although the size of Radcliff makes it one of the larger cities in the state of Kentucky – which could provide a good base for a regional wastewater district – it is a considerable distance from Brandenburg in terms of wastewater conveyance. The economy of scales, even considering the combined populations of the two communities, would not be adequate to justify the cost of conveyance to Radcliff for the relatively small amount of flow from the City of Brandenburg.

Approximately five miles to the southeast lies Doe Valley, a private lakeside community with a population of approximately 1,900 that currently owns and operates a wastewater collection and treatment system. Though close in proximity to Brandenburg and having a relatively large customer base, Doe Valley has recently built a new 200,000 GPD extended aeration package treatment plant. As a result, expanding the planning area to include Doe Valley was not considered.

H. Planning Scope

The tasks undertaken as part of this Planning Study are restricted to the 2020 Planning Area previously described and shown in Exhibit 2-6. The plan will include information and evaluations to assure that the most cost-effective and environmentally sound means of achieving the established water quality goals can be implemented.

The planning process involved investigating the environmental conditions of the 2020 Planning Area; evaluating treatment alternatives; evaluating the cost-effectiveness, environmental, engineering, public support, regionalization, and implementation impacts of each alternative; and selecting a recommended plan.

The Facilities Plan Update includes the following elements:

1. A description of population trends expected inside the 2020 Planning Area along with a description of the projected wastewater flows associated with the projected trends.

2. Descriptions of the existing wastewater collection and treatment system components. These descriptions include all elements of the system from the collection sewers through treatment to the ultimate discharge of treated wastewater to the Ohio River.

3. An assessment of inflow and infiltration in the existing sewage collection system.

4. A cost-effective analysis of alternatives for both the new treatment plant and wastewater collection system.

5. An identification of effluent discharge limitations.

6. A non-monetary effectiveness analysis which assesses the expected environmental, engineering, public support, regionalization, and implementation impacts of the disinfection alternatives.

7. A description of the Agreed Order (AO) and Corrective Action Plan (CAP). A copy of the AO can be found in Appendix A, while the CAP can be found in Appendix B.

8. A description of the selected alternative for the new treatment plant and collection system improvements.

9. Required comments or approvals from relevant federal, state, and local agencies.

10. A summary of public meetings and hearings held during the planning process, including a summary of the views expressed.

11. A statement demonstrating that the authorities implementing the plan have the legal, financial, institutional, and managerial resources available to ensure the construction, operation, and maintenance of the proposed treatment plant and collection system improvements.

I. Physical and Environmental Setting

1. Land Use

The City of Brandenburg has an existing zoning map (October 2012) including residential, commercial, industrial, and agricultural zones. Additionally, there are a few locations not included within this zoning map that currently contain sanitary sewer customers. These zoning locations were used to designate the existing land uses that are shown in Exhibit 2-4. From this land use map, the following table was developed which gives the land use acreages and percentage of total area.

Table 2-1
Existing Brandenburg Land Use

Land Use Designation	2020 Acreage	% of Total Area
Single Family Residential	584	21.0%
Two Family Residential	274	9.9%
Multi-Family Residential	185	6.6%
Commercial	765	27.5%
Industrial	339	12.2%
Utilities	37	1.3%
Agriculture	594	21.4%
Total Area	**2,778**	**100.0%**

As is evident from the above table, the most common uses of land in the City are single-family residential, commercial, and agriculture.

The heaviest concentration of residential land use is around the downtown area of the city. As the City has grown in size, the residential development has occurred east, west, and south of downtown along the major roads in and out of city center: Broadway, High Street, Hillcrest Drive, and Lawrence Street.

Commercial land use within the City of Brandenburg is predominately located along the By Pass Road corridor from Broadway west to Hillcrest Street, along the Broadway corridor from Meade-Olin Road south to By Pass Road, and along the Old Ekron Road corridor from Happy Ridge Road south to By Pass Road. Additional pockets of commercial land are located around downtown and in the northwestern part of the City along By Pass Road. The By Pass Road corridor is expected to continue to attract commercial development since it is the main thoroughfare to access the bridge crossing the Ohio River from Kentucky to Indiana.

Industrial use is generally concentrated in the southeast and west sections of the City. Currently, there is the 58-acre Bill Corum Industrial Park located on Armory Road. Additionally, there are individual industrial land use sites located along the By Pass Road and Broadway corridor.

The Meade County-Brandenburg Industrial Development Authority is continually trying to bring additional industrial development to the park, as well as other parts of the City and County. Monument Chemical, approximately one and a half miles northeast of the Brandenburg WWTP, is the largest industry in the area. The inclusion of Nucor in the Brandenburg–Meade County area will greatly expand the industrial footprint in the area. However, like Monument Chemical, the Nucor facility will utilize its own wastewater treatment plant and will not contribute flow or loading directly to the Brandenburg WWTP.

The Monument Chemical site operates a 9.34 MGD on-site treatment plant. However, it is not designed to treat municipal (domestic) wastewater. Monument Chemical's plant is almost 30 times larger than the Brandenburg WWTP meaning, a major expansion at the Brandenburg WWTP would be needed if they were to ever consider serving the industry. After numerous conversations with Monument Chemical, it does not appear imminent that either the City would serve the industry, or the industry would take the City's flows to their plant. As a results, this study does not investigate either option.

Existing agricultural land use is concentrated on three large plots of land within the city limits. The two largest located in the west on Lawrence Street and south on Old State Street account for 17.7% of the city's land usage.

The following table gives the estimated future land use acreages and percentage of total area. Exhibit 2-5 shows these future land use designations. The future land use is based on the city's planning area expanding to include existing water customers that don't currently have sanitary sewer service, as well as potential commercial and industrial growth in the eastern part of the city. The existing land usage areas remained the same for future land use projections. From the future land use map, Exhibit 2-5, the following table was developed which gives the land use acreages and percentage of total area.

Table 2-2
Brandenburg Future Land Use

Land Use Designation	Future Acreage	% of Total Area
Single Family Residential	1,278	34.0 %
Two Family Residential	274	7.3 %
Multi-Family Residential	185	4.9 %
Commercial	1025	27.3 %
Industrial	959	25.5 %
Utilities	37	1.0 %
Total Area	**3758**	**100.0 %**

2. Topography and Drainage Patterns

Meade County is located in the Mississippian Plateau, or Pennyroyal Region, of Kentucky. The county is bounded on the north by the Ohio River, on the east and south by Hardin County, and the west by Breckinridge County. Meade Country's terrain is mostly a karst (sinkhole) plain of low relief. The lowest elevation, approximately 383 feet, is the normal pool of the Ohio River. The highest elevation, approximately 1,004 feet, is found on Bee Knob Hill, near Flaherty, Kentucky.

Meade County and the Brandenburg Planning Area are part of the Ohio River Drainage Basin. The Brandenburg Planning Area drains either directly to the Ohio River or drains to Flippins Run which flows directly into the Ohio River. The majority of the Planning Area drains to the Flippins Run – Ohio River watershed (HUC_12 051401041001). The northwest portion of the Planning Area drains to the French Creek – Ohio River watershed (HUC_12 051401041002). The above mentioned watersheds and drainage patterns are shown in Exhibit 2-7.

The existing Brandenburg sanitary sewer collection and treatment systems were originally designed to work with the natural terrain and follow the existing drainage patterns of the area. As the collection system has expanded, the terrain has resulted in numerous lift stations and short force mains being required.

The collection system flows from west to east and south to north to the North Main Lift Station, which pumps east to the WWTP.

The wastewater treatment plant is located east of downtown Brandenburg, and approximately 0.36 miles south of its outfall on the Ohio River.

3. Wetlands

The National Wetland Inventory was referenced to determine the presence of wetlands, if any, in the Brandenburg Planning Area. There are several small wetland areas located throughout the Planning Area. The wetlands types included freshwater emergent wetland, freshwater forested/shrub wetland, freshwater pond, and riverine. The majority of the wetlands were freshwater pond. The freshwater ponds are classified as Palustrine Unconsolidated Bottom Permanently flooded. These were found scattered across the entire Planning Area. The second most common wetland type was the freshwater forest/shrub wetland. The forest/shrub wetlands are classified as Palustrine Forested Broad-Leaved Deciduous Temporary, Semipermanently, or Seasonally Flooded. These were found around the forested area along Flippins Run. Identified wetland areas are shown in Exhibit 2-7.

4. 100-Year Floodplain

The FEMA Flood Map Service Center was referenced to determine the extent of the 100-year floodplain of the Ohio River and Flippins Run in relation to both the City of Brandenburg and the Planning Area boundaries. Exhibit 2-8 shows the 100-year floodplain in the Planning Area. As shown on the map, flood hazard areas inundated by the 100-year floodplain are present along the Ohio River and Flippins Run. The floodplain along the Ohio River lies mostly outside the city limits and Planning Area boundaries, but does include portions in the northeast. The flood hazard areas along Flippins Run lies mostly outside of the city except in the northeast. Flippins Run's floodplain does cut across the eastern portion of Planning Area. This area has been designated as future industrial land use. There does not appear to be significant existing development along either floodplain, with the exception of the North Main Lift Station and Waterfront Park in the northeast part of the City.

5. Surface Water Quality

Referencing the 305 (b) Water Quality Report to Congress (2014), the following streams and lakes in Meade County were listed: Doe Run, Doe Valley Lake, Otter Creek, Wolf Creek, and the Ohio River. Doe Run, Otter Creek, and the Ohio River were found to not support or only partially support one or more of their intended uses. Doe Valley Lake was found to either fully support, or was not assessed for its intended uses. Wolf Creek has not been assessed for its intended uses. In addition, the 303 (d) List of Impaired Waters named Otter Creek, Doe Run, and the Ohio River as impaired streams and as having Total Daily Maximum Loads (TMDLs). Otter Creek and Doe Run's only causes for impairment were fecal coliform. Suspected sources include landfills, livestock, municipal point source discharges, and unspecified urban stormwater. The Ohio River's cause for impairment include Escherichia Coli (E. Coli.), Methylmercury, and Polychlorinated Biphenyls (PCBs). Suspected sources were listed as unknown.

Concerning the stream segments listed as impaired, from the 305 (b) and 303 (d) reports, Doe Run was found to not support primary contact recreation use. Otter Creek was found to only partially support primary contact recreation use. The Ohio River was found to not support primary contact recreation use and only partially support warm water aquatic habitat use and fish consumption.

Currently, the City of Brandenburg's WWTP discharges into the Ohio River (National Hydrography Dataset mile point 643.3).

6. Geology and Groundwater

The Kentucky Geological Survey at the University of Kentucky was referenced for information regarding the geological features and groundwater resources in the Brandenburg Planning Area. Meade County is part of the Mississippian Plateau, or Pennyroyal Region.

The Mississippian Plateau consists of a limestone plain. The plain is characterized by sink holes, sinking streams, streamless valleys, springs, and caverns. The terrain type of the Mississippian Plateau has been defined as Karst Terrain.
The thick deposit of Mississippian-age limestone and groundwater has led to the development of the longest cave system in the world, Mammoth Cave-Flint Ridge cave system.

Groundwater is of concern in the Brandenburg Planning Area because it supplies the City with their drinking water, as well as a few domestic water wells. Referencing the Water Treatment Plant Expansion Preliminary Engineering Report (March 2012 - GRW), the three existing wells can produce high iron and magnesium concentrations. These are both monitored and treated at the WTP to stay within the AWWA recommended limits. A fourth well was abandoned due to the presence of ammonia.

7. Water Wells

Water well records for the Planning Area were obtained from the Kentucky Geological Survey. This information shows a number of domestic, monitoring, remediation, industrial, public, and unknown water wells throughout the Planning Area, which are presented in Exhibit 2-7. Additionally, the Water Treatment Plant Expansion Preliminary Engineering Report (March 2012 - GRW) was referenced for information regarding the City's water wells. The wells are located in the Brandenburg Riverfront Park adjacent to the Ohio River and northeast of the downtown area. The city currently has three operating wells providing the main water source to the Brandenburg Water Treatment Plant. A fourth well has been abandoned in the same area. Two of the wells have a capacity of 700 GPM and one has a capacity of 500 GPM. Additionally, there are a few domestic wells in the southwestern portion of the planning area. The wellhead protection areas for the public water wells are also shown on Exhibit 2-7.

8. Soils

A soils map for the Brandenburg Planning Area is shown in Exhibit 2-9. Information for this map was obtained from the NRCS Soil Surveys Geographic Database. The most common types of soils in the Planning Area are: Baxter very gravelly silt loam, karst, 12 to 20 percent slopes, eroded; Hammack-Baxter Complex, karst, 6 to 12 percent slopes, eroded; Baxter very gravelly silty clay loam, karst, 12 to 20 percent slopes, severely eroded; Baxter very gravelly silt loam, karst, 6 to 12 percent slopes, eroded.

Baxter very gravelly silt loam, karst, 12 to 20 percent slopes, eroded (BaD2) soils occur on hills, are well drained, have a depth to water table of greater than 80 inches, and have no frequency of flooding or ponding. This type of soil is not well suited for septic uses due to restricted permeability and steep slopes. It has moderate corrosion characteristics for concrete pipe and has high corrosion characteristics for steel pipe.

Hammock-Baxter complex, karst, 6 to 12 percent slopes, eroded (HbC2) soils occur on ridges, are well drained, have a depth to water table of greater than 80 inches, and have no frequency of flooding or ponding. This type of soil is not well suited for septic uses due to restricted permeability and steep slopes. It has moderate corrosion characteristics for concrete pipe and has high corrosion characteristics for steel pipe.

Baxter very gravelly silty clay loam, karst, 12 to 20 percent slopes, severely eroded (BbD3) soils occur on hills, are well drained, have a depth to water table of more than 80 inches, and have no frequency of flooding or ponding. This type of soil is not well suited for septic uses due to restricted permeability and steep slopes. It has moderate corrosion characteristics for concrete pipe and has high corrosion characteristics for steel pipe.

Baxter very gravelly silt loam, karst, 6 to 12 percent slopes, eroded (BaC2) soils occur on ridges, are well drained, have a depth to water table of 80 inches, and have no frequency of flooding or ponding. This type of soil is not well suited for septic uses due to restricted permeability and steep slopes. It has moderate corrosion characteristics for concrete pipe and has high corrosion characteristics for steel pipe.

9. Plant and Animal Life

There are currently federally listed endangered or threatened species within the Brandenburg Planning Area vicinity.

According to the Kentucky Department of Fish and Wildlife, the Gray Bat, Northern Bat, Indiana Bat, and Bullhead Mussel are species on the Federal List of Endangered and Threatened Species that can be found in Meade County. The Gray Bat is listed as threatened, and Northern Bat, Indiana Bat, and Bullhead Mussel are listed as endangered.

The Indiana and Gray Bats live in caves or cave-like habitats and are located in floodplains near rivers or lakes where they feed in the summer. Causes of decline include white-nose syndrome, flooding, the increased use of pesticides on insects, pollution and siltation of streams that have caused a reduction in aquatic insects, and man made changes to cave entrances. The Northern Bats live in old-growth forests for the summer months and caves, mines, and tunnels for hibernation. Causes of decline include white-nose syndrome, loss of mature habitat, and hibernation disturbance. The Bullhead Mussel lives in large rivers and can inhabit medium rivers and reservoirs. Causes of decline include Zebra Mussels, point and non-point source pollution, and habitat destruction due to development.

As selected projects identified in this Facilities Plan are implemented, appropriate measures will be taken to identify, preserve and minimize disturbance to these species in accordance with all applicable State and Federal regulations.

10. Septic Systems

Septic tanks operate through the bacterial breakdown of sewage solids. This breakdown causes the sewage to separate into three layers within the tank: a bottom sludge layer that is slowly digested by bacteria, a middle layer consisting of relatively clear water containing minute particles, and an upper layer consisting of floating solids or scum. Baffles or tees within the tank retain the sludge and scum layers for further treatment and storage, while the middle layer, or clear zone, is discharged to the lateral field for disposal and treatment.

The treatment process's final step is the lateral field, which treats the wastewater by allowing it to trickle down through the soil. As the wastewater percolates to the groundwater below, the filtration process and organisms in the soil work together to clean the effluent. The soil acts as a biological filter to remove bacteria, viruses, and other pollutants from the septic tank effluent. This process can effectively treat the wastewater to acceptable levels that will not contaminate the groundwater. The size and type of lateral field is determined by the anticipated amount of water to be discharged into the system on a daily basis.

The most common system, which can be used on either level land, or moderate slopes with adequate soil depth above the water table/restrictive horizon, is the conventional rock lateral system. The liquid, or effluent, flows from the septic tank through solid piping to one or more distribution boxes, and then into perforated piping within gravel filled trenches. From there, the effluent then seeps into the soil. This conventional "lateral lines" process has a limited application within the Planning Area. In areas where soil doesn't percolate well individuals can consider using recirculating media or mound-type systems.

The Meade County Environmental Services was contacted in April 2017 to discuss the existence and condition of septic tanks in the 1990 Brandenburg Planning Area. The Department did not have knowledge of any specific locations of septic systems within the City proper. The County began keeping records of private septic systems in the mid 1980's. A list of all the County's private septic systems are organized by address. Currently, no general information is known or recorded by Environmental Services about the condition of existing septic systems or straight pipes in Meade County and/or the City of Brandenburg. All existing residents being added to the 2017 Brandenburg Planning Area are assumed to have septic tanks.

11. Drinking Water

The Brandenburg Water System currently serves approximately 1,512 customers. The Water Treatment Plant (WTP) is located on the east side of the City on Trailridge Road. The well field is located north of the WTP in Brandenburg Riverfront Park adjacent to the Ohio River. It consists of three wells with a capacity of 500-700 gallons per minute each that pumps to the WTP through a 12-inch raw water transmission main.

The WTP was completed in 1999 and has a rated capacity of 1.0 million gallons per day (MGD), with a recent average daily pumping demand of 0.50 to 0.60 MGD. This demand is down from approximately 0.76 MGD in 2015 due to the City losing the Meade County Water District as a customer. The plant was originally constructed with a chemical building, filter building, a one million gallon clearwell, and a high service and backwash pump station.

In 2015, the WTP was upgraded to include the following changes: renovations to various processes of the plant, including demolition of the existing caustic feed process, demolition of the existing gaseous chlorine storage/feed process, and remodeling of all the chemical rooms, including the addition of sodium hypochlorite and sodium permanganate; replacement of the filter media in the process filters; general renovations including painting in the filter building, chemical building and high service pump building; electrical upgrades including a new automatic transfer switch, lightning protection, a new quick connection plug for the portable generator at the well fields, and modifications to the SCADA MTU.

The water system currently has a total storage capacity of 1.45 MGD distributed between one clearwell located at the WTP and two elevated storage tanks. The older tank has a capacity of 250,000 gallon and is located in the City's south side on Old State Road. A new 200,000 gallon elevated water storage tank located on the north side of the City off Lawrence Street (KY 228) was completed in late 2018.

12. Air Quality

The air quality in Brandenburg and Meade County is generally good.

The Kentucky Division for Air Quality Fiscal Year 2016 Annual Report was referenced for specific information regarding results in the Brandenburg area, which are discussed below.

The U.S. Environmental Protection Agency Air Quality Index (ARI), which is an index for reporting daily air quality and associated health effects of concern, only has monitors in Jefferson, Bullitt and Hardin Counties in the vicinity of the Planning Area. In 2015, Bullitt and Hardin County had 1-2 days where the ARI was above 100, or in the "Unhealthy for Sensitive Groups" range, and Jefferson County had 8-12 days where the index was above 100.

The Kentucky Division for Air Quality monitors carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and hazardous air pollutant (toxic) levels at select monitoring locations throughout the state. Again, the only monitors near the Brandenburg Planning Area were in Jefferson, Bullitt and Hardin Counties.

According to the 2016 Report and in reference to the National Ambient Air Quality Standards (NAAQS), the following conclusions were found regarding air quality monitoring results.

There were zero exceedances statewide of carbon monoxide, which is only monitored in Jefferson County. There were zero exceedances for lead standards, which is only monitored in Jefferson County. There were zero exceedances statewide of nitrogen dioxide, which is monitored in Jefferson County and a few other counties across Kentucky. Jefferson County was the only county to record a fourth highest daily maximum in exceedance of the eight-hour standard for ozone across the state. Bullitt and Hardin Counties both recorded zero exceedances of ozone. There were zero exceedances statewide of particulate matter, which is monitored in Jefferson, Hardin, and a number counties across the state. Jefferson County had one exceedance over the daily maximum 1-hour average for sulfur dioxide and was the only site with an exceedance. Sulfur dioxide is monitored across numerous counties in the state.

There is only one National Air Toxics Trends Stations (NATTS) monitor in Kentucky to monitor hazardous air pollutants. This monitor is located in Eastern Kentucky, and the results wouldn't be representative of Brandenburg's air quality.

13. Climate

The climate of the Brandenburg Planning Area is temperate and favorable for many kinds of plants and animals with no extreme weather conditions. The Brandenburg area has an annual average temperature of 54.95° F, an annual average high temperature of 66.8° F, and an annual average low temperature of 43.1° F. In general, the summers are warm and humid with average temperatures around 86° F and heat peaking in the month of August.
The winters are moderately cold with average temperatures around 24° F and coldest average temperature in the month of January. Snow fall typically occurs between the December 1st and March 1st, with an average annual snowfall of 12.5 inches.

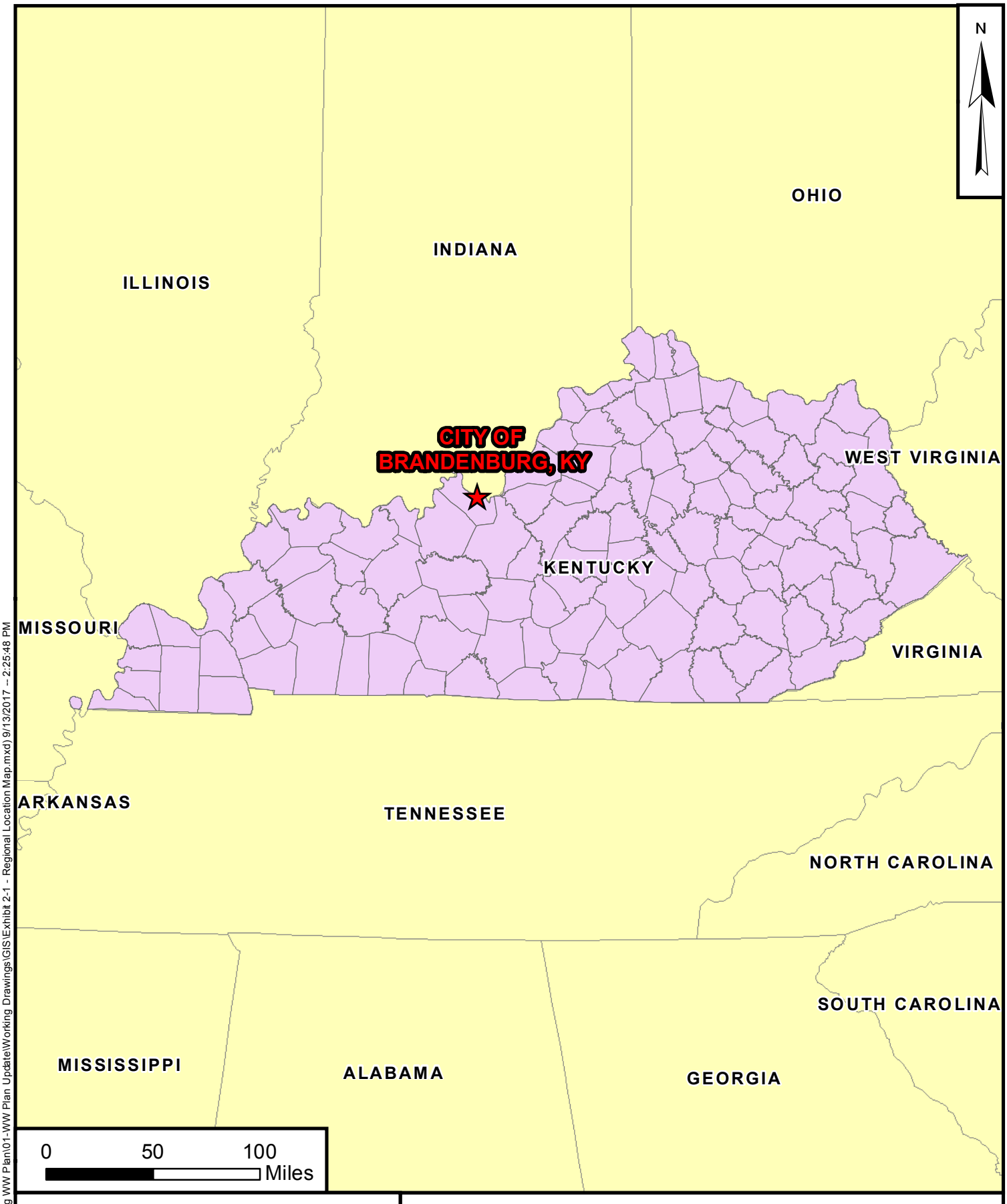
Precipitation is distributed reasonably well throughout the year, with no distinct wet or dry season. Annual precipitation averages about 49-inches. Major droughts are infrequent, but dry periods during the growing season are not uncommon.

14. Historic Sites

The City of Brandenburg was established in 1825 when the Meade County General Assembly authorized Solomon Brandenburg's Landing and Ferry as the seat of justice for Meade County. The town was named after Solomon Brandenburg, who donated the land for the county courthouse. Based on the town's location on the river, Brandenburg prospered as a trade center. The town was also known for Solomon Brandenburg's old log tavern, which hosted John James Audubon, Aaron Burr, and James Wilkinson.

Many historic sites and structures exist in and around the City of Brandenburg. The following sites and structures are listed on the National Register of Historic Places:

- Brandenburg Commercial District, Main St.
- Brandenburg Methodist Episcopal Church, 215 Broadway
- Doe Run Creek Historic District, KY 448
- Doe Run Mill, KY 1638
- Goff-Baskett House, 550 Lawrence St.
- Jones-Willis House, 321 Main St.
- Meade County Clerk Office-Rankin House, 205 Lafayette St.
- Meade County Jail, 125 Main St.
- Richardson House, 547 Lawrence St.
- Yeakel, Edward, House, 116 Decatur St.



Map Document: (G:\4556-Bburg WW Plan\01-WW Plan Update\Working Drawings\GIS\Exhibit 2-1 - Regional Location Map.mxd) 9/13/2017 – 2:25:48 PM

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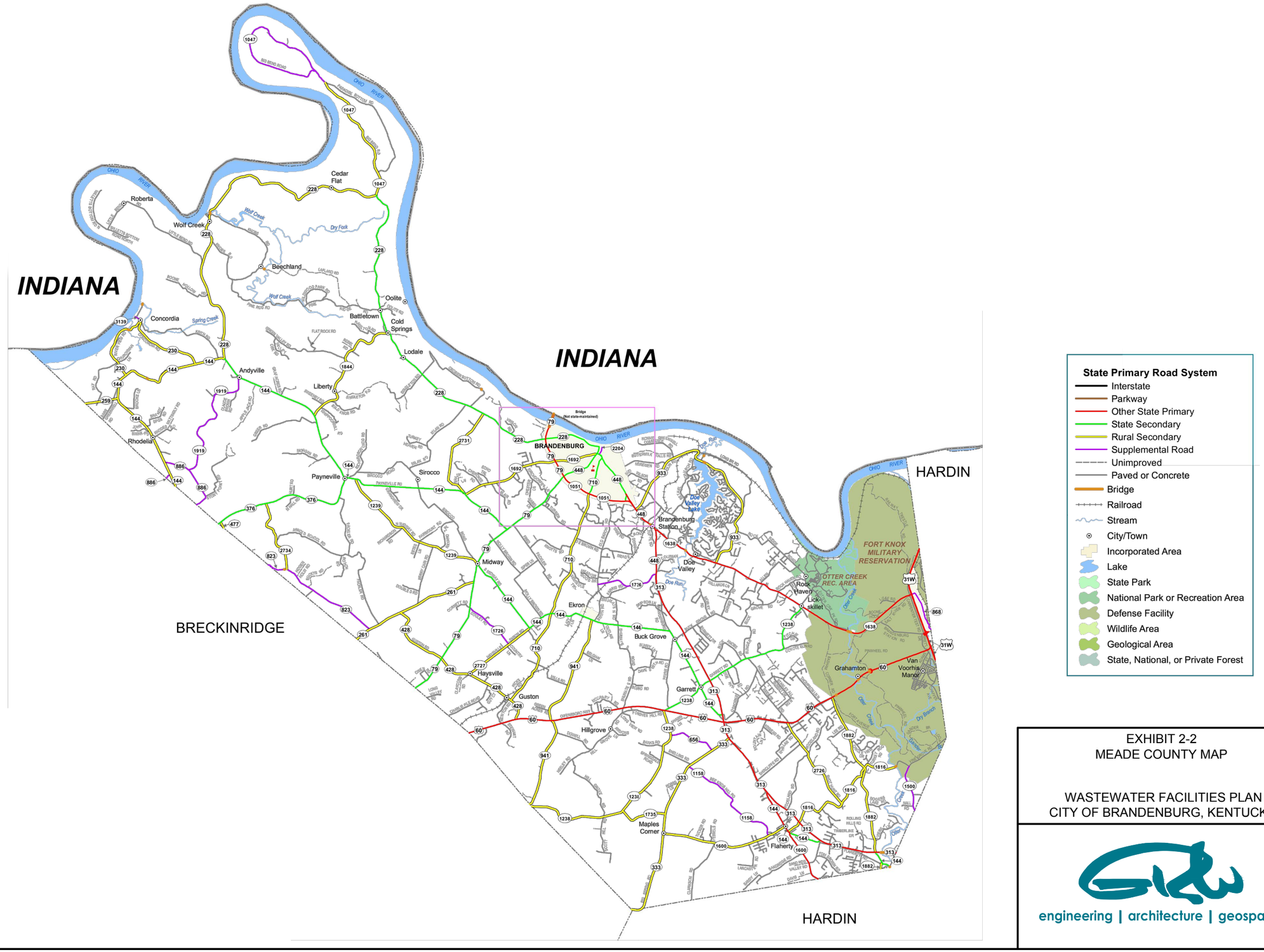
EXHIBIT 2-1
Wastewater Facilities Plan
Regional Location Map

CITY OF BRANDENBURG, KENTUCKY



State Primary Road System

- Interstate
- Parkway
- Other State Primary
- State Secondary
- Rural Secondary
- Supplemental Road
- Unimproved
- Paved or Concrete
- Bridge
- Railroad
- Stream
- City/Town
- Incorporated Area
- Lake
- State Park
- National Park or Recreation Area
- Defense Facility
- Wildlife Area
- Geological Area
- State, National, or Private Forest

EXHIBIT 2-2
MEADE COUNTY MAP

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

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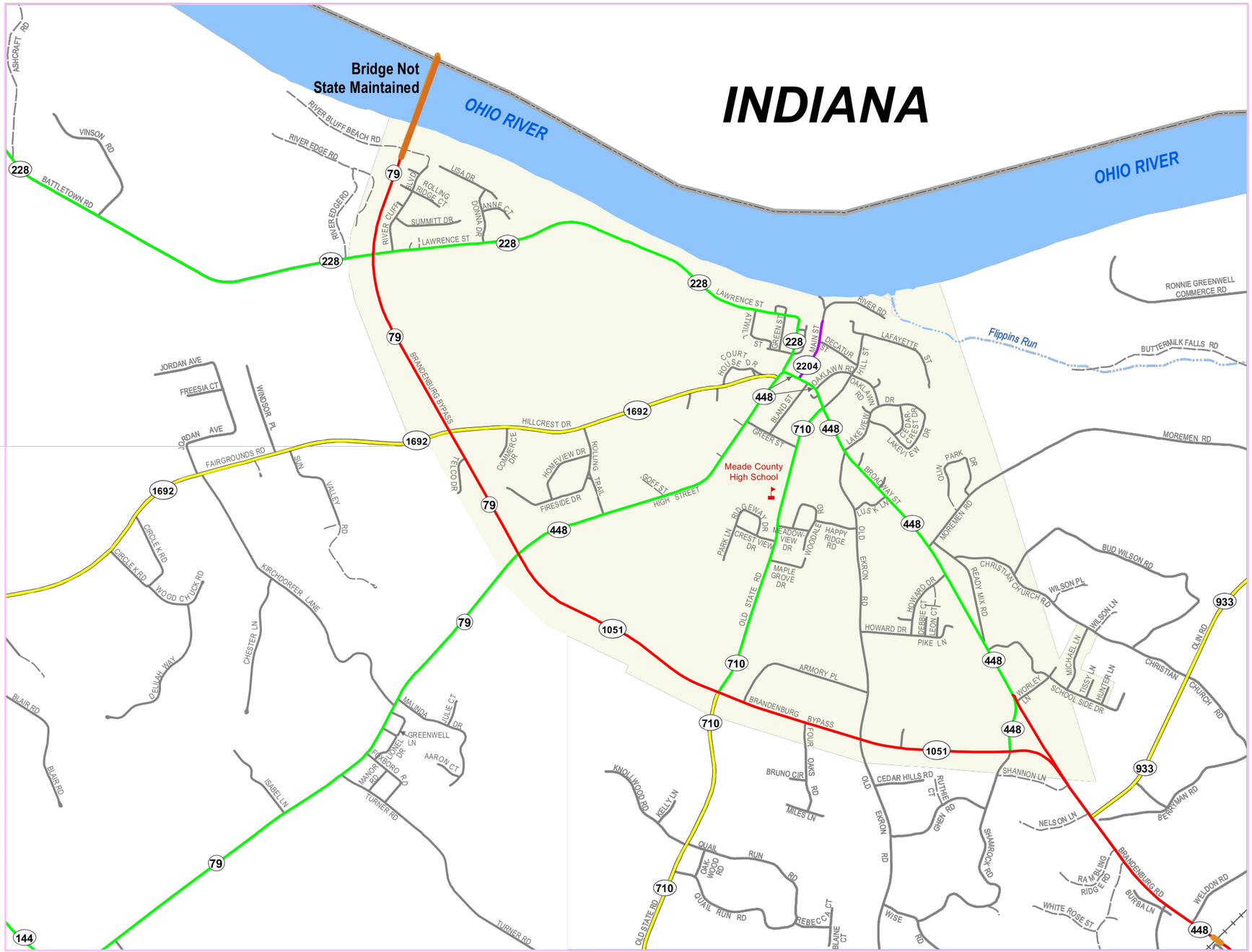

State Primary Road System

- Interstate
- Parkway
- Other State Primary
- State Secondary
- Rural Secondary
- Supplemental Road
- Unimproved
- Paved or Concrete
- Bridge
- Railroad
- Stream
- City/Town
- Incorporated Area
- Lake
- State Park
- National Park or Recreation Area
- Defense Facility
- Wildlife Area
- Geological Area
- State, National, or Private Forest

EXHIBIT 2-3
CITY OF BRANDENBURG MAP

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

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FILE NAME: G:\4556-Bburg WW Plan\01-WW Plan Update\Working Drawings\AutoCAD\Exhibit 2-3 - City of Brandenburg Map.dwg
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OHIO RIVER

KY 228

KY 1692

KY 79

BYPASS RD

KY 710

KY 448

KY 933

N

Legend

- Brandenburg WWTP
- 1990 Planning Area Boundary
- Brandenburg City Limits
- Roads
- River

Existing Land Use

- AG
- C-1
- C-2
- I-1
- I-2
- R-1
- R-2
- R-3
- U

0 2,000 4,000 Feet

EXHIBIT 2-4
Existing Land Use Map

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

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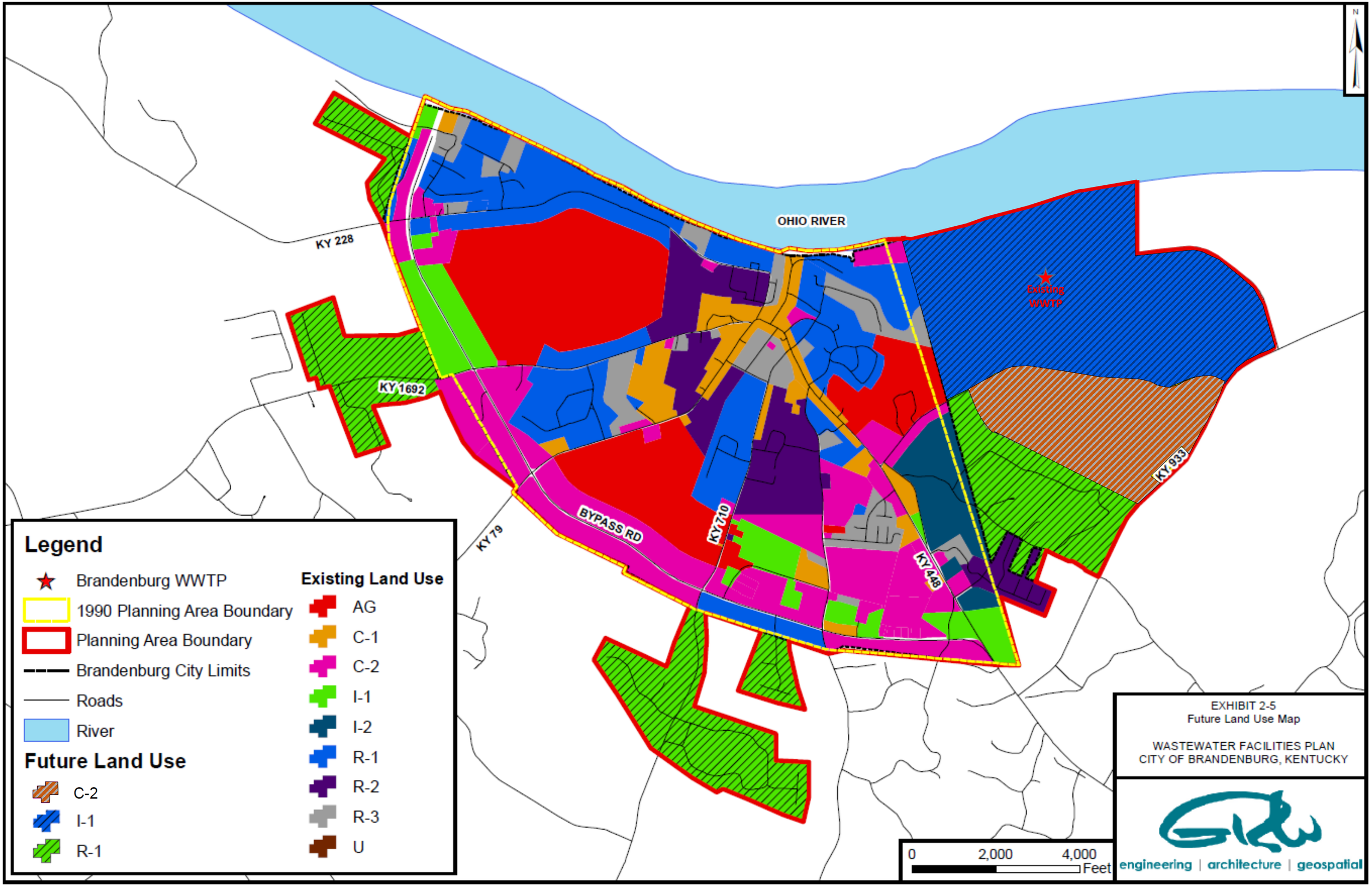
Map Document: (G:\4556-B\burg WW Plan\01-WW Plan Update\Working Drawings\GIS\Exhibit 2-4 - Existing Land Use Map.mxd) 4/6/2017 -- 10:19:57 AM


OHIO RIVER
KY 228
KY 1692
BYPASS RD
KY 79
KY 710
KY 448
KY 933
Existing WWTP
N
Legend
Brandenburg WWTP
1990 Planning Area Boundary
Planning Area Boundary
Brandenburg City Limits
Roads
River
Future Land Use
C-2
I-1
R-1
Existing Land Use
AG
C-1
C-2
I-1
I-2
R-1
R-2
R-3
U
0
2,000
4,000
Feet
EXHIBIT 2-5
Future Land Use Map
WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY
engineering | architecture | geospatial

OHIO RIVER

Existing WWTP

KY 228

KY 1692

BYPASS RD

KY 79

KY 710

KY 448

KY 933

Brandenburg

Legend

- Brandenburg WWTP
- 1990 Planning Area Boundary
- Planning Area Boundary
- Brandenburg City Limits
- Roads
- Existing Service Area
- 0-2 Year Planning Area
- 3-10 Year Planning Area
- 11-20 Year Planning Area

0 2,000 4,000 Feet

EXHIBIT 2-6
Planning Area Phasing

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

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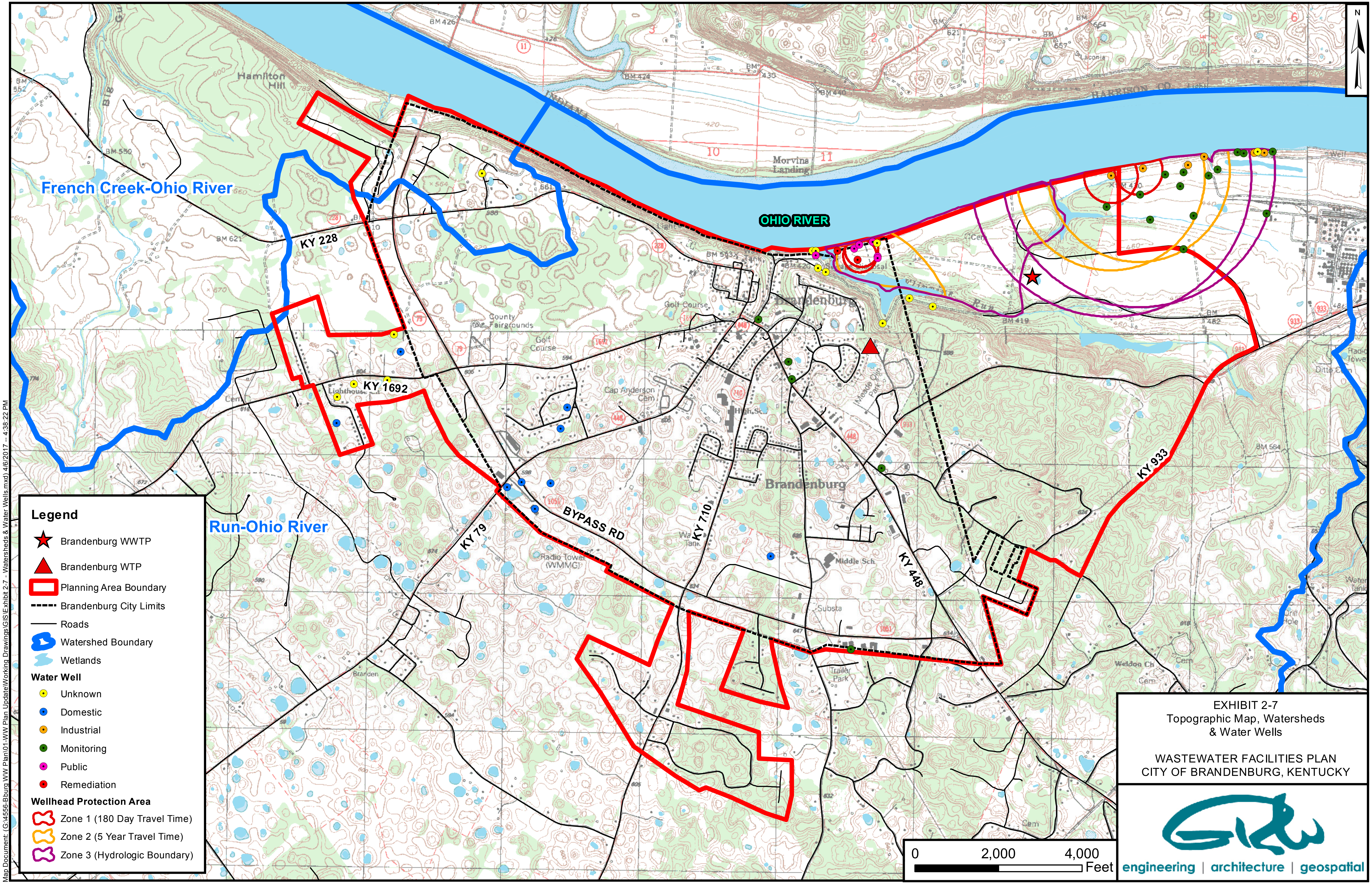

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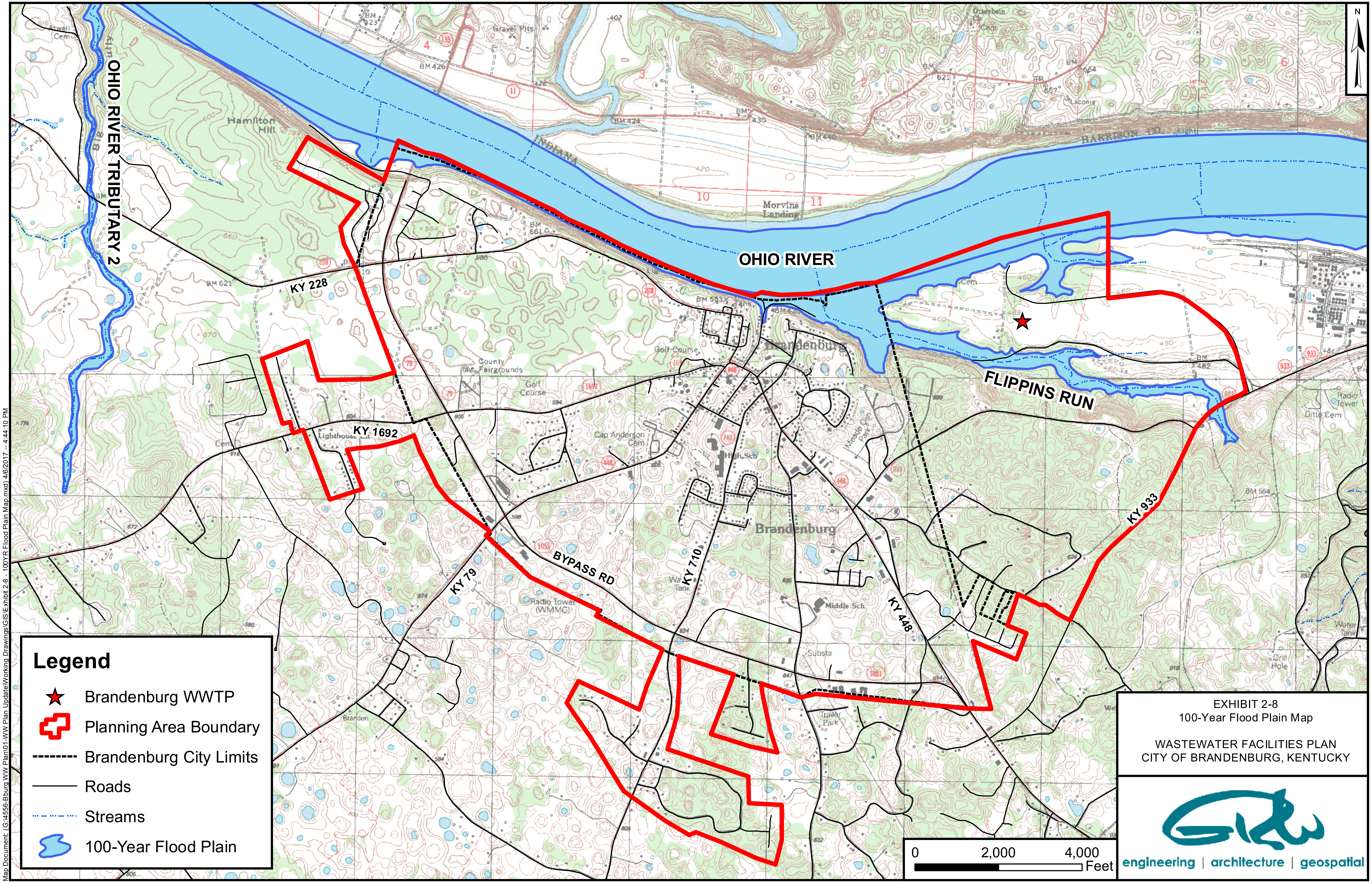

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Legend

- Brandenburg WWTP
- Brandenburg City Limits
- Planning Area Boundary
- Roads

MUSYM

- BaB2
- BaC2
- BaD2
- BaE2
- BbC3
- BbD3
- BeD4
- CkD
- CrB2
- CrC2
- CrD2
- CtC3
- EkA
- EkB
- EkC2
- EkE
- FcC2
- FcD2
- FrD3
- HaB2
- HbC2
- HbC3
- Hu
- Ld
- Ln
- MaD3
- Na
- NhC2
- No
- Nv
- RkF
- ScB
- W
- We
- WxC2
- uAlfD2
- uMelA

OHIO RIVER
KY 228
KY 1692
BYPASS RD
KY 79
KY 710
KY 448
KY 933

N

0 2,000 4,000 Feet

EXHIBIT 2-9
Soil Survey Map

WASTEWATER FACILITIES PLAN
CITY OF BRANDENBURG, KENTUCKY

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Map Document: (G:\4556-Bburg WW Plan\01-WW Plan Update\Working Drawings\GIS\Exhibit 2-9 - Soil Survey Map.mxd) 4/6/2017 -- 4:55:29 PM